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INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P2096 PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/CH 03/00721	International filing date (day/month/year) 04.11.2003	Priority date (day/month/year) 13.11.2002
International Patent Classification (IPC) or both national classification and IPC H01L33/00		
Applicant HEPTAGON OY		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:
 - I Basis of the opinion
 - II Priority
 - III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV Lack of unity of invention
 - V Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI Certain documents cited
 - VII Certain defects in the international application
 - VIII Certain observations on the international application

Date of submission of the demand 19.06.2004	Date of completion of this report 15.02.2005
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer van der Linden, J.E. Telephone No. +31 70 340-4525
	

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/CH 03/00721

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-20 as originally filed

Claims, Numbers

1-13 received on 04.02.2005 with letter of 02.02.2005

Drawings, Sheets

15-5/5 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:
- the drawings, sheets:

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5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).
(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)
see separate sheet

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees, the applicant has:
- restricted the claims.
 paid additional fees.
 paid additional fees under protest.
 neither restricted nor paid additional fees.
2. This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
- complied with.
 not complied with for the following reasons:
see separate sheet
4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:
- all parts.
 the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	9
	No: Claims	1-8,10-13
Inventive step (IS)	Yes: Claims	
	No: Claims	1-13
Industrial applicability (IA)	Yes: Claims	1-13
	No: Claims	

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2. Citations and explanations

see separate sheet

**INTERNATIONAL PRELIMINARY
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International application No. PCT/CH 03/00721

Re Item I

This report has been established as if some of the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c) PCT)

The amendments regarding new claims 1 and 13 filed with the letter dated 02.02.2005 introduce subject matter which extends beyond the content of the application as filed, contrary to Art. 34(2)(b) PCT, for the following reasons:

The subject matter of new claim 1 is based on original claim 2 and the addition that 'with the point sources of the housing receiving light from the source being assumed to act as secondary Lambertian point sources'. The latter wording is only disclosed in relation to the design process described on page 12, lines 8 - page 13, line 8 which furthermore includes the following features

- a. the electroluminescent element is an LED chip which is modeled as an array of point sources, each point source having the same (angular) light distribution as the LED chip
- b. the housing is modeled as a weighted, non-evenly spaced array of secondary point sources, with relative weights of individual sources in the array being calculated by considering how much energy (and under which angle) the corresponding point on the housing is receiving from the LED chip, i.e. from the primary point sources

The same argument applies to new claim 13 (based on original claim 16).

Re Item IV

The International Preliminary Examining Authority considers that the present application does not meet the requirements of Unity of Invention as required by Rules 13.1-13.3 PCT

The common concept linking independent claims 1,13 is a diffractive optical element (cf. clarity objection regarding claims 1,13 under Item V).

This common concept is not novel according to e.g. GALE M: "Replication techniques for diffractive optical elements", Microelectronic Engineering, 1997, vol. 34, pages 321-339. Since independent process claim 13 is directed to the 'manufacturing of a diffractive optical element', it is not specially adapted for the manufacture of the product of independent claim 1 (i.e. it does not inherently result in a 'light emitting device') - cf. PCT Guidelines under 10.12. Consequently, there remain no common or equivalent technical features between independent claims 1,13 and these claims define two separate inventions which are not linked such that they form a single general inventive concept.

Indeed, from a comparison of the disclosure of this prior art and the technical features of independent product claim 1, the special technical features (which make a contribution over this prior art - cf. Rule 13.2 PCT) are 'a light emitting device comprising an electroluminescent element arranged in a housing' which are neither the same as nor corresponding to those of independent process claim 13.

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Re Item V

Reasoned statement under Art. 35(2) PCT with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

- D1: EP 1 235 281 A (OMRON CORP) 28 August 2002
- D2: DHOEDT B ET AL: "Monolithic integration of diffractive lenses with LED-arrays" Journal Lightwave Technology, 1995, vol. 13, pages 1065-1073, ISSN: 0733-8724
- D3: WO 97 04491 A (SIEMENS AG) 6 February 1997
- D4: WO 99 25031 A (DONNELLY CORP) 20 May 1999

2

The present application does not meet the requirements of Art. 6 PCT, in that the matter for which protection is sought is not clearly defined. This lack of clarity is such that it influences the assessment of novelty and/or inventive step under Art. 33(2) and 33(3) PCT.

2.1 Claim 1:

The subject matter of this claim is unclear because an attempt is made to define a product by means of reference to certain steps in its manufacturing process, i.c. a light emitting device characterized by the method of manufacturing a diffractive optical element (part of the device).

2.2 Claim 13:

The designation of the subject matter of this claim, i.c. 'method for manufacturing a diffractive optical structure that is to be used in conjunction with an electroluminescent element arranged in a housing and/or substrate', is unclear since this is to be construed as meaning merely a 'method for manufacturing a diffractive optical structure'.

3

Notwithstanding the above-mentioned lack of unity, the present application does not meet the requirements of Art. 33(2) PCT, because the subject matter of the independent claims is not new

3.1 Claim 1 (original claim 2):

D1 describes (paragraphs 51-57, 82 and Figs. 1,16) a light emitting device (30) comprising at least one LED chip (12) and a Fresnel lens (18), representing a diffractive optical element (DOE) arranged to influence the light emitted by the LED chip, whereby the LED chip is arranged in a housing (13,20) which is coupled to the DOE.

The subject matter of independent claim 1 is therefore not new (Art. 33(2) PCT).

The subject matter of claim 1 is furthermore not new when considering D3 (page 6, line 12 - page 7, line 29 and Fig. 2) or D4 (page 18, line 8 - page 19, line 10 and Fig. 6,7).

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3.2 Claim 13 (original claim 16):

D2 describes (page 1066, paragraph 4 - page 1069, paragraph 13) a method of designing a DOE by modelling an EL light source as a set of point sources with the same angular light output distribution, designing a beam shaping optic for each point source, combining these beam shaping optics for all point sources to derive a total optical function, and generating a DOE structure corresponding to this total optical function.

The subject matter of independent claim 13 is therefore not new.

4

Dependent claims 2-12 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of Art. 33(2) PCT in respect of novelty and/or Art. 33(3) PCT in respect of inventive step, the reasons being as follows:

4.1 Claims 2-7,10,11:

D3 describes (page 6, line 12 - page 7, line 29 and Fig. 2) a light emitting device wherein an LED (11) is arranged with a substrate (9), provided with current supply means (8,13), and a DOE (27) comprising a plurality of sections is shaped into a surface of a transparent layer (1). The transparent layer is fixed to the substrate with its opposite surface and covers the light emitting surface of the LED.

The subject matter of these claims is therefore not new (Art. 33(2) PCT).

4.2 Claim 8:

D1 describes (paragraphs 51-57, 82 and Figs. 1,16) a light emitting device wherein an LED (12) is arranged into a housing (20), provided with current supply means (14,17), and encapsulated into a transparent material (13) fixed to the housing and comprises a DOE (18) structured into its surface.

The subject matter of this claim is therefore not new (Art. 33(2) PCT).

4.3 Claim 12:

D4 describes (page 10, line 19 - page 17, line 5 and Fig. 4) a light emitting device wherein the feature size of the DOE is on the order of micrometers.

The subject matter of this claim is therefore not new (Art. 33(2) PCT).

4.4 Claim 9:

The features of this claim merely represent one of several straightforward possibilities from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill, in order to solve the problem posed.

The subject matter of this claim does therefore not involve an inventive step (Art. 33(3) PCT).

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The subject matter of claims 1-13 meets the requirements of Art. 33(4) PCT because it is considered to be industrially applicable.

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WHAT IS CLAIMED IS:

1. A light emitting device comprising at least one electroluminescent element (1) and a diffractive optical element (12) arranged to influence light emitted by the electroluminescent element (1), characterized in that the diffractive optical features of the diffractive optical element (12) are designed according to the output light distribution of the one or more electroluminescent elements (1), and wherein the electroluminescent element (1) is arranged in a housing (2) and/or substrate coupled to the diffractive optical element (1), and the design of the diffractive optical features of the diffractive optical element (12) also incorporates the shape and reflection characteristics of the underlying housing (2), with the points of the housing receiving light from the source being assumed to act as secondary Lambertian point sources.
5
2. A light emitting device according to claim 1, wherein symmetry characteristics of the diffractive optical element (12) correspond to symmetry characteristics of the electroluminescent element (1), as well as to the symmetry characteristics of the desired emission characteristics.
10
3. A light emitting device according to one of the claims 1 to 2, wherein the diffractive optical element (12) is shaped in an at least partially transparent layer (11) which covers a light emitting surface of the electroluminescent element (1).
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4. A light emitting device according to claim 3, wherein the layer (11) does not extend over the light emitting surface of the electroluminescent element (1).
5. A light emitting device according to one of the claims 1 to 4 comprising a housing and/or substrate (2) for accommodating the electroluminescent element (1) and current supply means for the electroluminescent element (1),
5 wherein the diffractive optical element (12) is coupled to the housing and/or substrate (2).
6. A light emitting device according to claim 5, wherein said diffractive optical element (12) is directly and irreversibly fixed to the housing and/or substrate
10 (2).
7. A light emitting device according to claim 5 or 6 comprising an LED (light emitting diode) further comprising an LED chip as the electroluminescent element (1), a housing and/or substrate (2) and an at least partially transparent material (3) surrounding the electroluminescent element (1), wherein said diffractive optical element (12) is made up of diffractive optical structures (12)
15 on a surface of an at least partially transparent layer (11) attached to said at least partially transparent material (3).
8. A light emitting device according to claim 5 or 6 comprising an LED (light emitting diode) further comprising an LED chip as the electroluminescent element (1), a housing and/or substrate (2) and an at least partially transparent material (3) surrounding the electroluminescent element (1), wherein said diffractive optical element is made up of diffractive optical structures (12) on a surface of said at least partially transparent material (3).
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9. A light emitting device according to claim 7 or 8, wherein said at least partially transparent material (3) comprises light influencing additives, in particular a fluorescent material.
10. A light emitting device according to any one of the previous claims wherein
5 said diffractive optical element (12) comprises a plurality of independent sections each having an individual optical function.
11. A light emitting device according to any one of the previous claims, wherein
10 said electroluminescent element (1) comprises a light emitting surface wherein the light emitting surface is covered by at least partially transparent material (3), the at least partially transparent material (3) defining a first surface, wherein an at least partially transparent layer sticks to said first surface and defines a second surface essentially parallel to said first surface, and wherein said diffractive optical element (12) is made up of diffractive optical structures present in said second surface.
- 15 12. A light emitting device according to any one of the previous claims, wherein
said diffractive optical structure (12) comprises features having characteristic depths and/or heights of between 0.5 micrometers and 200 micrometers.
13. A method for manufacturing a diffractive optical structure that is to be used in
20 a light emitting device in conjunction with an electroluminescent element arranged in a housing (2) and/or substrate, the diffractive optical structure being arranged to influence light emitted by the electroluminescent element (1), comprising the steps of

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- modeling the light emission of the electroluminescent element (1) as an array of point sources, each point source having the same angular light distribution as the electroluminescent element as a whole, whereas the intensity is optionally adapted to a local emission strength of the
5 electroluminescent element;
- modeling light emission of secondary point sources corresponding to points where light leaving the electroluminescent element is reflected by said housing (2) and/or substrate before reaching the diffractive optical structure, and modelling the light emission of secondary point sources as
10 being lambertian;
- designing, for the desired light beam shape, a beam shaping optic for each point source;
- combining the beam shaping optics for all point sources, generating a total optical function; and
- generating a surface profile for the diffractive optical structure according to
15 the total optical function.